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**Navigation in Large Information Spaces
Represented as Hypertext:
A Review of the Literature**

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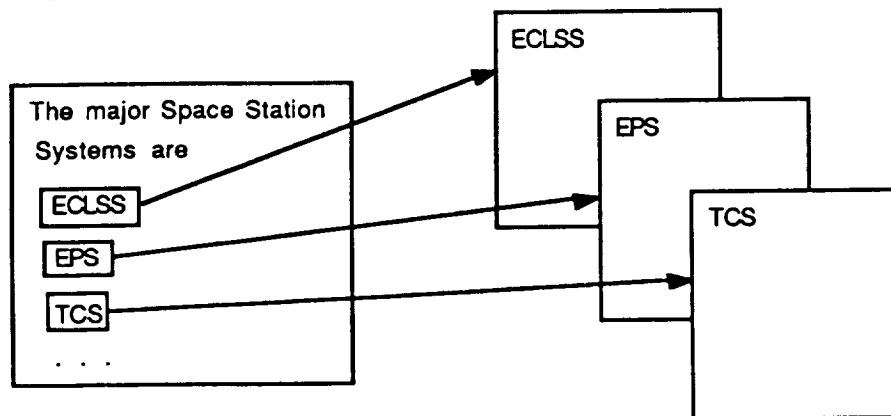
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Navigation in Large Information Spaces Represented as Hypertext: A Review of the Literature

Introduction

Although Vannevar Bush first proposed a hypertext-like interface to a large body of knowledge in 1945, only in the last few years has widespread interest in hypertext and hypermedia arisen. Hypertext is usually defined as non-linear text, meaning that it consists of text nodes and links between those nodes. In some hypertext systems, the nodes may be a paragraph long, while others may have nodes which contain entire documents. The links between the nodes allow the reader to move from one node to a related node. Each node is typically linked to several other nodes, allowing the reader to move to any of them, rather than leading to a single following node like the pages of a book. Hypermedia is an extension of this concept to include not only text but also drawings, pictures, even audio and video presentations.



This figure may give some feeling of a hypertext system. The text node on the left has several terms about which more information is available. By selecting one of those terms, the user is taken to a node which gives additional information. Those nodes will usually lead to other nodes with further information. The user can select the information she is interested in by stepping from node to node, following only those links that interest her. This process of moving

through nodes and links is commonly called navigation of the information space.

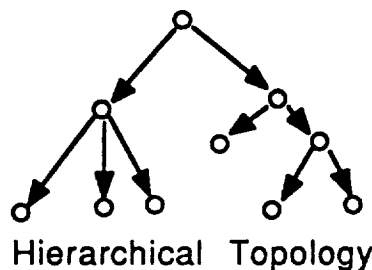
There has been very little research into the area of navigation of large information spaces in hypertext. (By large spaces, we are addressing hypertexts with more than 10,000 nodes.) Several of the obvious methods used in smaller information spaces break down quickly in the larger spaces. For example, graphical maps of the hypertext quickly become too large for adequate representation on a screen. One attempt to deal with this is to reduce the amount of information portrayed at each node in the graphical browser, but when the graph approaches even 1000 nodes, showing only the nodes (even as a dot) and their relationships becomes too much to display on a screen. Further, the user is incapable of grasping any useful information from such a cluttered screen.

The basic question we must address is clear: If many of the typical tools for navigation of information spaces fail when the space grows too large, how are we to facilitate navigation in large spaces?

Our basic goal must be to provide the power of the hypertext interface in such a way as to be most easily comprehensible to the user. We must keep the user's cognitive load as light as possible. Let the computer do the grunt work, and let the user use the tool.

Information Space Topologies

One way to simplify navigation is to restrict the topology, or arrangement, that the nodes of a hypertext are allowed to have. A topology that is used in a large number of different hypertexts is the hierarchy or tree.



A graph based on a hierarchy has several advantages in terms of navigation and conceptualization of the information space.

Use of a hierarchy allows abbreviation of the graphical representation of the graph, since branches which diverge higher than the current location in the graph can be pruned out of the display. A hierarchically-based graph preserves a definite sense of *up* and *down*. This helps keep the user oriented with a sense of more general (up) or more detailed (down), while links to other nodes at approximately the same level of detail proceed horizontally. The basic problem with a hierarchy is that we usually put given concepts under several different hierarchies. For example, we might file 'Abbott & Costello' under 'Movies', 'Baseball', 'Comedy' and 'Literature'. In a hypertext, we would want links from all those topics to (at least some of) the nodes about 'Abbott & Costello', and links from 'Abbott & Costello' to other nodes in all of those networks. So, ideally, information about 'Abbott & Costello' would be accessible from all those hierarchies. Obviously, this means a great deal of overlap. A given node might reside in many different hierarchies at the same time.

Conclusion

It is believed that the optimal structure for information is an overlapping, simplified hierarchy. The hierarchical structure should be made obvious to the user, and many of the non-hierarchical links in the information space should either be eliminated, or should be de-emphasized so that the novice user is not confused by them. Only one of the hierarchies should be visible at any given time, but switching to another should be very simple.

This research is discussed in more detail in a report I prepared for my NASA Colleague, Joe Hale. The report is also available from me at the University of Alabama.

